



PhD in CHIMICA INDUSTRIALE E INGEGNERIA

CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 39th cycle

THEMATIC Research Field: ELECTRIFIED STRUCTURED REACTORS FOR CATALYTIC PROCESSES

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Catalytic reactors where the heat of reaction is provided by electric energy plays a key role in the development of low-carbon H₂ technologies towards progressive decarbonization of industrial processes. It has been demonstrated that these reactors enable substantial reduction of CO₂ footprint of several chemical processes, and at the same time allow for process intensification and an increase of volumetric yield. Moreover, these systems enable also design of small-scale units enabling development of distributed processes and technologies. In this context Joule-heating of structured catalyst made of proper materials (Silicon Carbide) was demonstrated among the most effective methodology by LCCP research group, and was recently applied to H₂ production through methane steam reforming process or CO₂ valorization with methane dry reforming and reverse water gas shift. The objective of this research will be the testing, modelling and scale-up of a novel reactor configuration patented by LCCP research group in cooperation with an external company. The validation of advantages provided by this novel configuration will be proved at laboratory scale and then, scale-up considerations will be performed in view of a pilot-scale testing expected in 2026.
Methods and techniques that will be developed and used to carry out the research	The candidate will first accomplish a critical analysis of the possible materials to be used for design of an electrified



	reactor, performing characterization in terms of thermal and electric conductivity aimed at understanding the material stability and possible interactions in a reactive environment. Experimental testing of the advanced reactor configurations will be performed by adapting existing rigs at LCCP laboratories. The student will be called to design a reactor based on the proposed configuration, perform catalytic activation of the materials and execute in person reactive tests. The candidate will carry out kinetic investigations on commercial catalyst. In parallel, the candidate will develop adequate reactor models that will include heat and mass transfer and catalyst kinetics to allow the analysis of the experimental output. Upon validation, the mathematical model will be used to design of scaled-up units based on optimal geometrical configuration. In the last year of the research activity, the candidate is expected to carry out experimental tests at an industrial site where an existing pilot-scale reactor will be adapted to the new reactor configuration
Educational objectives	The candidate will gain high-level knowledge of experimental testing and modelling of advanced catalytic reactors and catalytic processes for the production of key energy vectors.
Job opportunities	The skills acquired by the candidate during the PhD programme will be useful for possible jobs in R&D roles of companies active in chemical processes design, catalyst manufacturers, EPC, oil and gas.
Composition of the research group	6 Full Professors 4 Associated Professors 10 Assistant Professors 20 PhD Students
Name of the research directors	Prof. Enrico Tronconi

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Confidentiality :

since this is a thematic scholarship, the management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary must sign a specific commitment.

Educational activities (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year:

- 1st year: around 1.900 euros per student
- 2nd year: around 1.900 euros per student
- 3rd year: around 1.900 euros per student.

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student: There are various forms of financial of for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.